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Health beverages from bayberry and yellow Himalayan raspberry

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ABSTRACT

In this study, total carotenoids, anthocyanins, total flavonoids, total phenolics and total antioxidant capacity (CUPRAC) of underutilized fruit crops like bayberry and yellow Himalayan raspberry based health beverages (ready-to-serve, RTS) were investigated. Feedback collected from the trained panel revealed significant (P <0.05) differences in appearance, colour, flavour and texture upon sensory evaluation of the beverages. Based on ranking, bayberry RTS was most preferred in overall appearance, colour and flavour. The higher acceptance of bayberry RTS among testers could be owed remarkably to its attractive red colour and appearance.

Keywords: Ready-to-serve, health beverages, antioxidants, sensory quality, bayberry, Himalayan raspberry

INTRODUCTION

A number of wild but potentially commercialized fruits are available in Himalayan regions of India (Mehta *et al.*, 2010). Of which, red fruited 'bayberry' (*Myrica esculenta* Buch. Ham. Ex D. Don) locally known as '*kaphal*' and 'Yellow Himalayan Raspberry' (*Rubus ellipticus* Smith) commonly referred as '*hisalu*' are amongst highly valued edible fruits (Kala, 2007). Kafal is an important medicinal tree distributed all along outer Himalaya from Ravi (Punjab) eastwards to Assam, in Khasia, Jaintia, Shimla, Bengal, Naga and Lushai hills at altitudes of 900-2100m. The tree can grow up from 3m to 15m. Pulp constitutes 75.4% of whole fruit and is edible with juice content of 40%. The juice possesses 3.68% acidity, 12.65% total sugars, which are mostly reducing sugars. The mineral content of the fruit pulp is 0.387% by its ash. The fruit pulp contains 0.97% protein, 0.007% phosphorus, 0.194 % potassium, 0.039% calcium, 0.013% magnesium and 0.004% iron (Panthari *et al.*, 2012). The tree is a popular remedy for different ailments and is documented for the same (Kala, 2007). The yellow Himalayan raspberry is one of the tastiest wild fruits, growing in abundance throughout the North-Western Himalayas (Singh *et al.*, 2011). Berry weight varies from 0.3-0.9 g, TSS from 10-20 ^{0}Brix and acidity 1.0-1.7%. Berry length varies between 7.8 to 14.37 mm, while berry breadth 10.03 to 15.85 mm. The reducing sugars range between 2.2% and 4.9%, non-reducing sugars from 5.9% to 11.5% and the ascorbic acid content ranges from 3.0 to 5.1mg/ 100g fresh pulp (Singh *et al.*, 2009).

These wild fruits have great potential in agro-processing as they are rich in malic acid, citric acid, tartaric acid and carbohydrates (Singh *et al.*, 2009). It would be advantageous to assess the antioxidant properties of these plants for possible use in the elaboration of functional foods or for consideration as potential sources of natural antioxidants (Rawat *et al.*, 2011; Trivedi *et al.* 2016). The objectives of the present investigation were to design alternative use of such underutilized crops, other than the fresh consumption, by developing new antioxidant rich health beverages.

MATERIALS AND METHODS

The present study was undertaken at ICAR-Central Institute of Temperate Horticulture, Regional Station, Mukteshwar, which is situated at 2250m above mean sea level. Fresh fruits of bayberry and yellow Himalayan raspberry were collected from forest area of Mukteshwar, District-Nainital, Uttarakhand, India.

Preparation of ready-to-serve (RTS) beverages

After proper washing, cleaning and sorting of *kafal* and *hisalu* fruits, juice was extracted through an electronic juicer (Philips, India). Fruit juices were added @ 100 ml/ L of finished product. The required acidity in ready-to-serve (RTS) was adjusted with citric acid. No preservative was added to the prepared product. Final RTS characteristics were adjusted to 0.3 % acidity and 13 % TSS. The step wise preparation of RTS has been presented in Fig. 1. Blended RTS was prepared by adding fruit juices of both *kafal* and *hisalu* @ 50 ml/ L; thereby, keeping total juice percentage constant i.e. @ 100 ml/ L of finished product.

Soluble solid content, titratable acidity, reducing and total sugars and pH

Brix was measured at 20 °C using an Abbe refractometor (Atago, Tokyo, Japan). Titratable acidity, reducing and total sugar were estimated as per

the method suggested by Ranganna (1986). The pH of the beverages was assessed using a pH meter (Inolab pH 730, Merck Specialities Pvt. Ltd., India).

Estimation of ascorbic acid, total carotenoids and total anthocyanin

The ascorbic acid and total carotenoids contents of the samples were estimated according to Ranganna (1986). Results were expressed on mg/ 100 ml. The total monomeric anthocyanin content was determined by the pH-differential method suggested by Giusti and Wrolstad (2003). The pigment content was calculated and expressed as mg cyaniding 3-glucoside (Cyd 3-glu) per L, using an extinction coefficient (Є) of 26,900 L/cm/ mol and a molecular weight of 449.2 gmol/L.

Determination of total flavonoids and total phenolics content

The estimation of total flavonoids was performed according to Chang *et al.* (2002). Results were expressed as mg of querecetin equivalents/ 100 ml. The results were expressed as mg phloroglucinol equivalents/ 100 ml. Total phenolic content was quantified spectrophotometrically employing Folin–Ciocalteu reagent and results expressed as gallic acid equivalents (mg GAE/100 ml) (Singleton and Rossi, 1965).

Antioxidant activity (Cupric reducing antioxidant capacity, CUPRAC)

CUPRAC assay was carried out by the method described by Apak *et al.* (2004) using copper (II) chloride, neocuproine and ammonium acetate buffer solutions. The antioxidant activity was expressed as mmol Trolox®/ liter, or mM TE.

Organoleptic evaluation for acceptability of the RTSs

Organoleptic evaluation was performed on beverage preparations by a ten-member trained panel. For each sensory parameter, such as colour and appearance, body or texture, flavour, taste and overall acceptability, 100 marks were allotted and the products were given to the panelist in coded form. (Attri *et al.*, 2014) The panelists washed their mouths with water intermittently to evaluate samples. Significant differences were determined at the (P<0.05) level of significance using the Duncan's multiple range tests.

Statistical analysis

Experiments were laid in complete randomized design with three replications. Duncan's Multiple Range Test was used to determine significant differences. Significance was determined at P<0.05.

RESULTS AND DISCUSSION

Besides commercial fruits, the consumption of wild and underutilized fruits is also gaining importance owing to their antioxidant contents and consequently health benefits (Krishna and Parashar, 2013). As these underexploited fruits are available for a very short period, the value added products will definitely help to provide taste throughout the year if processed during the growing season (Nandlal and Bhardwaj, 2014). Underutilized fruit crops can be utilized by designing alternative use, other than the fresh consumption, by developing new antioxidant rich beverages (Krishna *et al.*, 2014). The results of our investigation show that both bayberry and yellow Himalayan raspberry based health beverage possess high content of various antioxidants (Table 1). The total carotenoids contents were found to be highest in RTS prepared from *hisalu*, while the least was recorded in RTS from *kafal*. Yellow coloured berries are reported to be rich source of carotenoids (Egea *et al.*, 2010). On the other hand, *kafal* RTS had the highest contents of anthocyanin, while it was not detected in RTS prepared from *hisalu*. *Kafal* or *M. esculenta* broadly resembles with *Myrica rubra*, found commonly in China and Japan, which is also reported to have high anthocyanin contents (Rawat *et al.*, 2011). The high total antioxidant activities of *kafal* RTS can be attributed to presence of higher contents of phenolics and anthocyanin. Higher values of phenolics and anthocyanin has been reported to contribute towards higher total antioxidant activities in many other crops like mulberry (Krishna *et al.*, 2012); *Rhododendron* (Krishna *et al.*, 2014) and blended squashes of *Rhododendron arboreum*, *Berberis asiatica*, *Crataegus crenulata* and *Galgal* (Attri *et al.*, 2014).

Results of the trained sensory panel are presented in Fig. 3. Feedback collected from the trained panel revealed significant (P <0.05) differences in appearance, colour, flavour and texture upon sensory evaluation of the beverages. Based on ranking, bayberry RTS was most preferred (P <0.05) in overall appearance, colour and flavour (Fig. 2, Fig. 3). The least values were scored by the bayberry-yellow raspberry blended RTS on all sensory attributes. The higher acceptance of bayberry RTS among testers could be owed remarkably to its attractive red colour and appearance. Likewise, Attri *et al.* (2014) reported that among the 10 blended squash involving *Rhododendron arboreum*, *Kilmora* (*Berberis asiatica*), *Ghengharu* (*Crataegus crenulata*) and *Galgal* (*Citrus pseudolimon*), treatment combination *Rhododendron* (15%) + *Galgal* (5%) + ginger (5%) was adjudged the best in terms of overall sensory attributes due to its pleasant red colour.

It can be concluded that both bayberry and yellow Himalayan raspberry, which are highly perishable in nature and are available for short period can be utilized effectively by preparing health beverages. Earlier, Dwivedi and Ahmed (2008) successfully attempted to make squash and nectar from seabuckthorn, a crop rich in antioxidants, which is now being commercialized owing to its huge health attributes. Therefore, exploiting the phytochemical contents of underutilized fruits, like bayberry and yellow Himalayan raspberry, could offer the enormous opportunities for devising better marketing strategies for the sale of beverages made of it (Krishna *et al.*, 2014).

Figure 1. Flow chart of ready-to-serve (RTS) beverage preparation

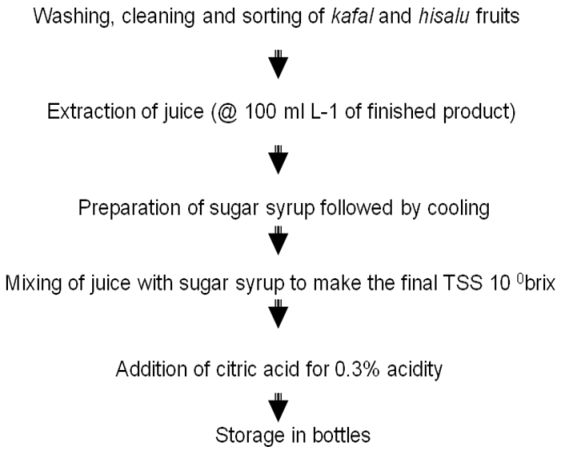


Figure 2. RTSs prepared from *kafal* and *hisalu*(From left to right: *Kafal* RTS, *Hisalu* RTS and Blended RTS)

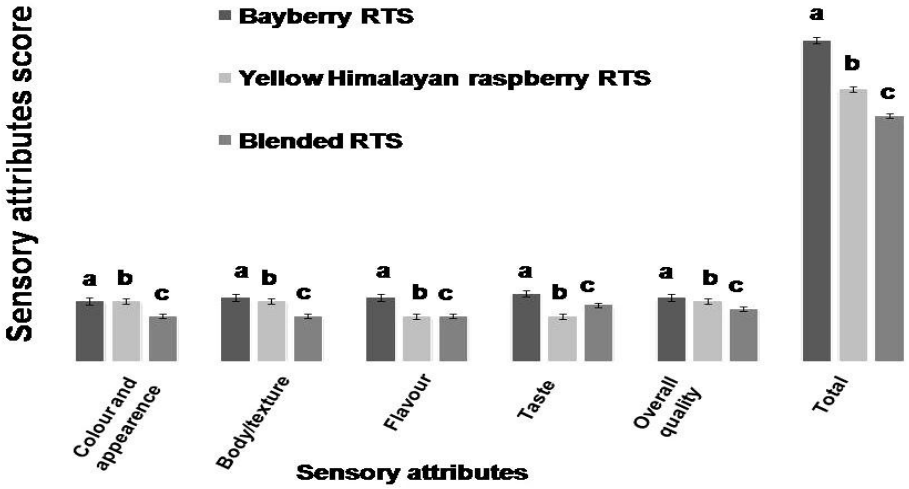
Table 1. Quality characteristics of different ready-to-serve (RTS) beverages

Quality attributes	Bayberry RTS	Yellow Himalayan raspberry RTS	Blended RTS
Soluble solid content, SSC (^{0}Brix)	10.0±0.7a	10.0±0.4a	10.0±0.6a
Reducing sugars (%)	4.2±0.4a	4.7±0.5a	4.5±0.2a
Total sugars (%) Quality attributes	9.7±0.6a	9.3±0.3a	9.6±0.2a
Acidity (%)	0.3±0.01a	0.29±0.01a	0.3±0.01a
SSC: acid ratio	33.3±0.3a	34.5±0.4a	33.3±0.4a
Ascorbic acid (mg 100ml^{-1})	0.2±0.0c	2.1±0.3a	0.98±0.1b
Total carotenoids (µg 100ml^{-1})	29.7±0.7c	516.9±8.2a	297.5±4.3b
Total flavanoids (mg 100ml^{-1})	25.4±1.3a	16.2±1.7c	20.6±0.4b
Total anthocyanins (mg L^{-1})	1.58±0.4a	-	0.77±0.1b
Total phenols (mg 100ml^{-1})	45.2±1.0a	14.5±0.6c	27.9±0.3b
Total antioxidant capacity (mM Trolox Equivalent (TE) L^{-1})	4.95±0.2a	1.47±0.1c	3.19±0.3b

Data represents means of three samples (n=3) ± s.d.

Values are mean of three replicates. Means followed by different letters in a row are significantly different ($p<0.05$).

Figure 3. Sensory analysis of different ready-to-serve beverages



Values followed by the same letter are not significantly different (P <0.05). Each value is expressed as mean ± standard deviation (n = 3).

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